REMARKS/ARGUMENTS

Reconsideration and allowance in view of the foregoing amendment and the following remarks are respectfully requested.

Claims 1 and 6 have been rejected under 35 USC 103(a) as unpatentable over Owen et al in view of Jones and Perry's Chemical Engineering Handbook. Applicant respectfully traverses this rejection.

The concept of the invention is based on the principles of communicating vessels. According to the invention as defined in claim 1, and as illustrated by way of example in Figure 2 of this application, the system is formed by the following elements:

a) dip leg (24) of secondary cyclone (22);
b) dip leg (23) of the primary cyclone (21);
c) point of junction (25) of the dip legs of the in-series components;
d) bed of catalyst (9) into which the unique dip leg (26) formed by the junction of dip legs (23,24) from the in-series cyclones (21,22) is immersed;
e) open type termination (31) of the unique dip leg (26); and
f) catalyst flows through the cyclones dip legs, which constitutes one of the variables that will define the level of catalyst in the above components.

To underscore and clarify the above features and the unique characteristics of the invention, claim 1 has been further amended above to specify that the dip leg 23 of the primary cyclone 21 extends straight and vertically aligned with the center axis of the primary cyclone as does the single cyclone separator leg downstream of the junction of the primary and secondary cyclones, whereas the leg of the secondary cyclone is inclined. Claim 1 has further been amended to recite even more specifically that the level of fluidized bed set forth in claim 1 refers to not just to the level outside the legs of the cyclones, but to the level inside the dip legs as schematically illustrated in applicant's Figure 2.

The better sealing efficiency results achieved in accordance with the invention, which allow cyclones to be operated in series with high concentration of catalyst feed, is

obtainable due to the existence of a catalyst level at a higher position than the position of the junction point of the dip legs that form the unique dip leg characterizing applicant's invention (See Figure 2), as now more specifically required by amended claim 1. Then, some operational conditions are appropriately observed. For example, the pressure at the upper part of the primary cyclone 21 of the invention is higher than the pressure at the top of the secondary cyclone. An idea of the invention is to prevent this pressure difference from causing a flow to be established from primary dip leg 23 through junction 25 and then upwards through secondary dip leg 24 to the lower pressure secondary cyclone 22. This would disrupt the equilibrium in the cyclone system, causing an unacceptable drop in collecting efficiency. The operation of the in-series set of cyclones is only effectively obtained with the existence of a catalyst level inside the dip legs above the junction of the in-series cyclones and it is the quality of the effective sealing in said junction that establishes the good performance realizable with the invention.

The dip leg of the primary cyclone, due to the great amount of catalyst flow, can operate by using an open termination without incurring an efficiency loss of particles collections. However, the dip leg of the secondary cyclone, due to low catalyst flow and pressure (about 1000 times less than the primary stage) conventionally demands sealing means (a plate for example). This constitutes a problem because it allows gas to flow without control to the interior of the dip leg.

The present invention represents an innovation as it proposes a solution to eliminate the sealing means for the dip leg of the secondary cyclone and to avoid those problems related to bad functioning and on stream failures (failure during operation). The new manner of operating according to the invention is a self-control sealing system, provided that those conditions mentioned above are observed (i.e. positioning of the junction point combined with the open termination of the unique dip leg).

Thus, when the system of the invention is in operation, the level of the catalyst bed has to be above the junction of the dip legs and the pressures resulting from catalyst flow into the cyclones (top of dip leg primary cyclone, top of dip leg secondary cyclone and termination of unique dip leg) appropriately balanced.

It is respectfully submitted that, in view of the foregoing, the configuration of the apparatus claimed is not a matter of choice since the improper configuration and disposition of the dip leg may lead to a collapse in the operation process, since the behavior of catalyst flow is different from the flow of a continuous fluid, such as for example a liquid.

A further feature of the invention now more specifically set forth in claim 1 is that the dip leg of the primary cyclone is substantially vertical, as is the cyclone separator leg, whereas the secondary cyclone dip leg is inclined to the junction with the primary dip leg.

Owen teaches in Figure 1 a primary cyclone 65 and a secondary cyclone 67 wherein the leg of the secondary cyclone and the leg of the primary cyclone form a single primary and secondary cyclone leg complex. However, in the Owen structure, the dip leg of the primary cyclone is inclined, not straight and vertical as required by applicant's claim 1, whereas the leg of the secondary cyclone is straight. Furthermore, the dip leg of Owen possesses movable sealing part means (trickle valve) at the leg termination.

Owen's application is applicable to Positive Cyclones Systems, as depicted by its picture, where the primary cyclone (65) inlet is connected to a rise (51). Therefore, the fluidized bed vessel (73) pressure is lower than pressures at the cyclones dip legs from the primary and secondary cyclones. Applicant's invention is adapted to Negative Cyclones Systems, because the primary cyclone (21) inlet is at the same pressure as the fluidized bed vessel. Therefore, the pressures at the top of the cyclones' dip legs are lower than those at the fluidized bed vessel (31). This difference is fundamental to

determine the proper performance for the invention. Applicant's invention works better in both cases, although applicant's invention is directed to Negative Cyclone Systems. It is well known in the state of the art of cyclones, that there are no sealing problems in Positive Cyclone Systems. That is why Owen uses two separated plenum chambers in his invention, besides the sulfur reduction in streams for posterior treatment plenum chamber 79 for the Positive Cyclone System (comprising cyclones 65 and 67) and another one (plenum chamber 93) for the Negative Cyclone (89). Besides, it is important to emphasize that the Negative Cyclone (89) uses a movable conventional sealing (probably a trickle valve), the elimination of which applicant's invention is advancing, due to its low performance.

As noted above, Owen provides sealing means at the termination of the combined dip legs. The Examiner cites the secondary reference to Jones as allegedly teaching terminating a cyclone separator leg distally in a radius curved termination that is devoid of movable sealing parts. Applicant respectfully disagrees for the reasons of record.

Indeed, Applicant respectfully submits that Jones does not teach the combination claimed devoid of movable sealing parts. Quite the contrary, Jones' invention specifically provides for a mechanical closure on a dip leg that is selectively released and, thus, expressly teaches a movable sealing part.

The Examiner asserts that Jones' sealing plate is only present when catalyst is introduced and is only temporary and will be removed during operation by the presence of a weight to pull a metal plate out of position or by forming the sealing means from a material that will partly or wholly fuse or rupture or disintegrate. However, the Examiner has by this admission acknowledged that Jones <u>does</u> teach a mechanical sealing part for the distal end of his dip leg and <u>does</u> teach that at least a part of the mechanical closure is movable. As such, Jones does <u>not</u> anticipate a distal termination

that is devoid of movable sealing parts. Jones invention expressly provides for a mechanical closure placed on the dip leg.

Even if Jones is considered to teach a radius curved termination that is devoid of movable sealing parts, Jones does not teach or suggest such a termination for a common dip leg of multiple cyclones, much less for a separator leg joining a leg of a secondary cyclone and a primary cyclone.

It is further respectfully submitted that Owen clearly and irrefutably teaches sealing means at the end of his common dip leg. Since Jones does not teach or suggest that the sealing means can be omitted or eliminated from such a common dip leg, it is respectfully submitted that the skilled artisan would not obviously replace the sealing means of Owen with a radius termination as in Jones. Only applicant teaches that a radius termination devoid of movable parts may be incorporated at the termination of a common dip leg from different cyclone stages. Importantly that feature of the invention is not an isolated characteristic but must be considered in combination with the remaining features of applicant's independent claim 1, including the location of the fluidized particles with respect to the junction of the dip legs and the vertical orientation of the dip leg of the primary cyclone and inclined orientation of the dip leg of the secondary cyclone. This combination is clearly not taught or suggested by the prior art combination cited by the Examiner.

Thus, Owen/Jones does not anticipate the combination claimed because neither Owen nor Jones teach, in combination, (1) the level of the fluidized bed located above that junction; (2) a substantial vertical primary cyclone leg and an inclined secondary dip leg; and (3) the separator leg terminates in a radius-curved separator leg termination that is devoid of movable sealing parts.

Regarding claim 6, the Examiner's suggestion that Owen is "silent" as to the vertical distance between the junction and the discharge end is not well taken.

The performance of the apparatus of applicant's invention depends on the distance between the junction point and the distal end of cyclone leg termination, plus it requires that the junction point be also <u>immersed</u> in the fluid bed (see Figure 2 and claim 1). The following situations can occur:

a) if this distance is too short, the efficiency of primary cyclone is not affected, but the efficiency of secondary cyclone is affected in such a manner that the whole system fails, and catalyst is thrown up into the environment; this happens because a minimum distance is needed below the junction in order that gas does not flow from the fluidized bed into the secondary cyclone dip leg, due to low pressure at the top of this dip leg, and also due to the fact that it is slanted relative to vertical. Even if a long radius curve is used, catalyst fluidizes in the initial stretch of the unique leg and if the junction is in this region, gas will flow towards the secondary cyclone dip leg causing collection efficiency to be reduced.

b) if this distance is too large- and this means that the length from the primary cyclone 21 bottom to the junction is accordingly too small- the junction may be located in a region where the catalyst flow still shows the presence of not a regular amount but a large amount of gas carried from the primary cyclone [a thing which is not widely known], while a catalyst is flowing along the dip leg, the catalyst releases a large proportion of the entrained gas which returns to primary cyclone without effecting the collection efficiency. The catalyst flow changes if regime from a fluidized bed flow to a dense bed flow. The junction has to be installed in the dense bed flow region, lest instead of the excess entrained gas returning to the primary cyclone dip leg, the same must flow towards the junction and towards the secondary cyclone dip leg. This will drastically reduce the collection efficiency of the cyclone system, even to efficiencies smaller than those using a single cyclone leg;

c) if this distance is large and the fluidized bed catalyst level is much below the junction, it may possibly happen that the sealing of the junction point will fail (the

presence of catalyst level above the junction point will not be accomplished), and an undesired secondary gas (mainly) and catalyst stream will arise from the primary cyclone dip leg towards the secondary cyclone dip leg. The efficiency will fall to unacceptable levels, even worse then using a single state cyclone;

d) if restriction in the leg termination is not adequate, the invention will not function due to lack of catalyst mass for flowing (without restriction) or due to lack of flow (too restrictive).

The invention operates based on the pressure balance among the "communicating vessels", which comprise the fluidized bed, cyclones legs, junction point of the legs, and considering head loss of primary and secondary cyclones, catalyst level in the catalyst bed in relation to the junction point, and also, the type of leg termination.

In summary, Owen is not just silent as to the vertical distance between the junction and the discharge end, but provides <u>no teaching</u> or suggestion whatsoever in this regard. Even if Jones' removable closure plate and curved tip were applied to dip leg 41, neither Owen nor Jones provides any teaching whatsoever as to the position of the junction of the legs relative to the radiused/curved termination. Thus, it is submitted that claim 6 is patentable over Owen and Jones.

For all the reasons advanced above it is respectfully submitted that claims 1 and 6 are not anticipated by nor obvious from Owen taken alone or in combination with Jones and Perry's Handbook.

Claim 3 was rejected under 35 USC(a) as unpatentable over Owen in view of Jones and Perry's Chemical Engineering Handbook and further in view of Danielsen. Applicant respectfully traverses this rejection.

Claim 3 is submitted to be patentable over Owen in view of Jones and Perry's Chemical Engineering Handbook for the reasons advanced above. The Examiner's

further reliance on Danielsen does not overcome the deficiencies of Owen in view of Jones noted above. In fact, Danielsen also teaches away from the invention by providing a movable sealing part at the distal end of the leg structure.

It is therefore respectfully submitted that claim 3 is also allowable over the prior art of record.

Claims 4 and 5 were rejected under 35 USC 103(a) as unpatentable over Owen view of Jones and Perry's Chemical Engineering Handbook and further in view of Luckenbach. Applicant respectfully traverses this rejection.

These claims are submitted to be patentable over Owen and Jones for the reasons advanced above. The Examiner's further reliance on Luckenbach does not overcome the deficiencies of Owen and Jones noted above. In fact, Luckenbach also teaches away from the claimed invention because Luckenbach discloses movable sealing parts in direct contradiction to the combination claimed in applicant's claim 1 and the claims dependent therefrom.

It is further respectfully submitted that Lukenbach does not teach or suggest that the radius curved portion of Owen/Jones could or should be formed from a plurality of straight pipe sections. In the case of Lukenbach, a single pipe part 14 is provided at an incline. Lukenbach does <u>not</u> teach that his inclined part is formed from a series of straight pipe sections; only a single pipe section is shown forming this component. Likewise, Lukenbach provides no teaching or suggestion whatsoever regarding using straight pipe sections to form a radius curve. In fact, if Lukenbach's teachings were followed in Owen/Jones, then Owen/Jones would provide a <u>single</u> straight segment at an incline as depicted in Lukenbach, rather than the single curved pipe. It is therefore, respectfully submitted that any proper combination of Owen/Jones and Lukenbach would still not anticipate nor render obvious the plural straight portions applicant claims in claims 4 and 5.

It is further respectfully noted that claim 5 provides that the succession of straight tube sections directs the mass flow against phase particles into a plane orthogonal to the ascending gas flow. This is not true of Jones as Jones clearly directs mass flow at an acute angle to and in the same direction as the gas flow, as understood from Figure 2. Thus, Jones does not teach or suggest a curve directing mass flow in a plane orthogonal to the gas flow direction. Lukenbach also fails to teach or suggest directing flow in a direction orthogonal to the gas flow because Lukenbach teaches mass flow directed downwardly at an acute angle to and in the opposite direction from the gas flow. Thus, any proper combination of Jones and Luckenbach does not anticipate nor render obvious claim 5 either.

It is therefore respectfully submitted that claims 4 and 5 are also patentable over the prior art of record.

All objections and rejections having been addressed, it is respectfully submitted that the present application is in condition for allowance and an early Notice to that effect is earnestly solicited.

Respectfully submitted,

NIXON & VANDERHYE P.C.

By: ______________________
Michelle N. Lester
Reg. No. 32,331

MNL:slj
901 North Glebe Road, 11th Floor
Arlington, VA 22203-1808
Telephone: (703) 816-4000
Facsimile: (703) 816-4100